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THE IRON AND STEEL INDUSTRY DURING BUSINESS CYCLES

WARREN M. PERSONS

THE census of manufactures of the United States classifies manufacturing industries into fourteen groups.[1] Of these groups "iron and steel and their products" leads all others, whether the groups be ranked according to capital investment, amount of wages paid, or value added to materials by the manufacturing process.[2] Moreover, the industrial importance of the iron and steel group is not fully revealed by the figures for that group considered by themselves. Among the other thirteen groups there are two, "vehicles for land transportation" and "railroad repair shops," which are so intimately connected with iron and steel that the three might well be classified together, while the remaining eleven manufacturing groups are all dependent upon the iron and steel industry for tools, machinery and structural steel. Furthermore, the non-manufacturing activities, agriculture, mining, building, and transportation, are large consumers of iron and steel products. The manufacture of iron and steel, therefore, is not only important because of its magnitude but because it is more intimately related to every phase of our industrial life than is any other branch of manufacturing activity.

Because of its importance and its unique interlocking with every branch of the modern industrial organization, the manufacture of iron and steel has been generally recognized to reflect the business situation as a whole. Direct evidence that this industry actually does offer good indices of business conditions may be found in various data published by the Harvard University Committee on Economic Research. We may remind the reader that in our original study, "Indices of General Business Conditions," we found the monthly volume of pig-iron production for 1903–14 to fluctuate concurrently with bank clearings outside New York City and general commodity prices. Consequently, pig-iron production was one of the series selected for our curve B representing general business conditions.[3] Comparison of the annual volume of pig-iron production with indices of the output of manufacture as a whole led Professor Day to the conclusion that "pig-iron production appears to give an amazingly accurate picture of the year-to-year fluctuation of physical production in manufacture."[4] Prices of iron and steel, as well as production, reflect the general business situation. The prices of pig iron and bar iron are included in our commodity price index of business cycles.[5] Finally, the price indices of iron and steel stocks fluctuate in a manner very similar to that of the indices of other industrial stocks.[6]

It is the object of this article to bring together the significant material showing the fluctuations of the iron and steel industry during periods of business prosperity and depression.

Prices. Chart I shows the monthly prices, 1898–1921, in dollars per gross ton, of four iron and steel products in various stages of manufacture, namely, Bessemer pig iron, Bessemer billets, steel bars, and black steel sheets.[7] The chart is constructed on the logarithmic scale, so that the equal vertical distances represent equal percentage changes. The important thing brought out by the chart is the manner in which fluctuations in the prices of pig iron are reflected in the prices of the semi-manufactured and manufactured products. During certain periods like 1902–03, 1905–07 and 1910, however, the prices of bars and sheets reveal a high degree of stability while pig iron and billets fluctuate considerably.

That fluctuations in the prices of iron and steel products during periods of business prosperity and depression are representative of fluctuations in prices of other important commodities is shown by Chart II. The curves on this chart represent the prices (B) of pig iron and (C) bar iron compared with (A) our ten-commodity price index of business cycles, based upon the prices of mess pork, cottonseed oil, hides, print cloths, sheetings, spelter, worsted yarns, and coke as well as pig iron and bar iron. This chart shows that the prices of pig iron and bar iron have similar cyclical movements to those of the ten-commodity index. The three curves have been adjusted for their respective long-time movements[8] during the period of comparison, 1898–1914, in order that the different long-time movements of the various price series might not interfere

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[1] The groups are: food and kindred products; textiles and their products; iron and steel and their products; lumber and its remanufactures; leather and its finished products; paper and printing; liquors and beverages; chemicals and allied products; stone, clay and glass products; metals and metal products, other than iron and steel; tobacco manufactures; vehicles for land transportation; railroad repair shops; miscellaneous industries.

[2] *Abstract of the Census of Manufactures*, 1914, p. 29.

[3] See the REVIEW for April, 1919, pp. 112, 113.

[4] *Ibid.*, December, 1920, p. 367.

[5] *Ibid.*, November, 1921, p. 363.

[6] *Ibid.*, August, 1921, p. 266.

[7] The price quotations for the four series are all taken from the *Iron Age*. For the period 1898–1919 tables of monthly averages of weekly quotations in Pittsburgh, and a chart based upon them, are given in the *Iron Age* for January 1, 1920. For the years 1920–21 similar averages are computed from the quotations given in the issues of January 6, 1921 and later. All quotations are there given in dollars per gross ton except those for black sheets No. 28 and steel bars, which we converted from cents per pound to dollars per gross ton.

[8] See the REVIEW for April, 1919 for an explanation of the method used. Lines of secular trend were fitted by the method of least squares to the prices of pig iron and bar iron for the period 1898–1914 and percentage deviations taken of the original items to the corresponding ordinates of secular trend. The same process was applied to each of the other series in our ten-commodity price index. The arithmetic average of the "percentage deviations from lines of secular trend" of the ten commodities constitutes the adjusted index (curve A of Chart II).

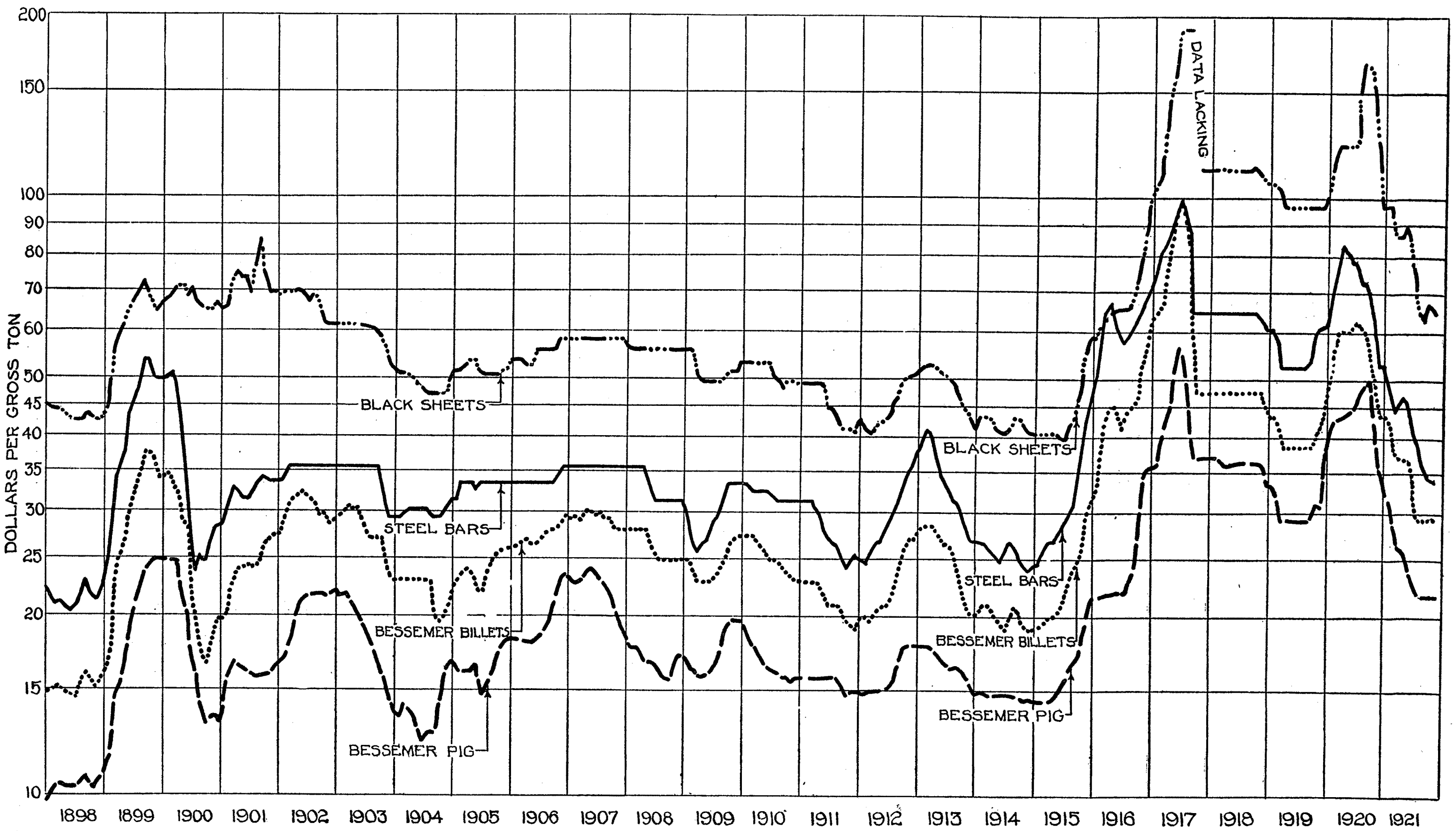

Chart I. — Monthly Prices in Dollars per Gross Ton, 1898–1921, of Bessemer Pig Iron, Bessemer Billets, Steel Bars, and Black Sheets

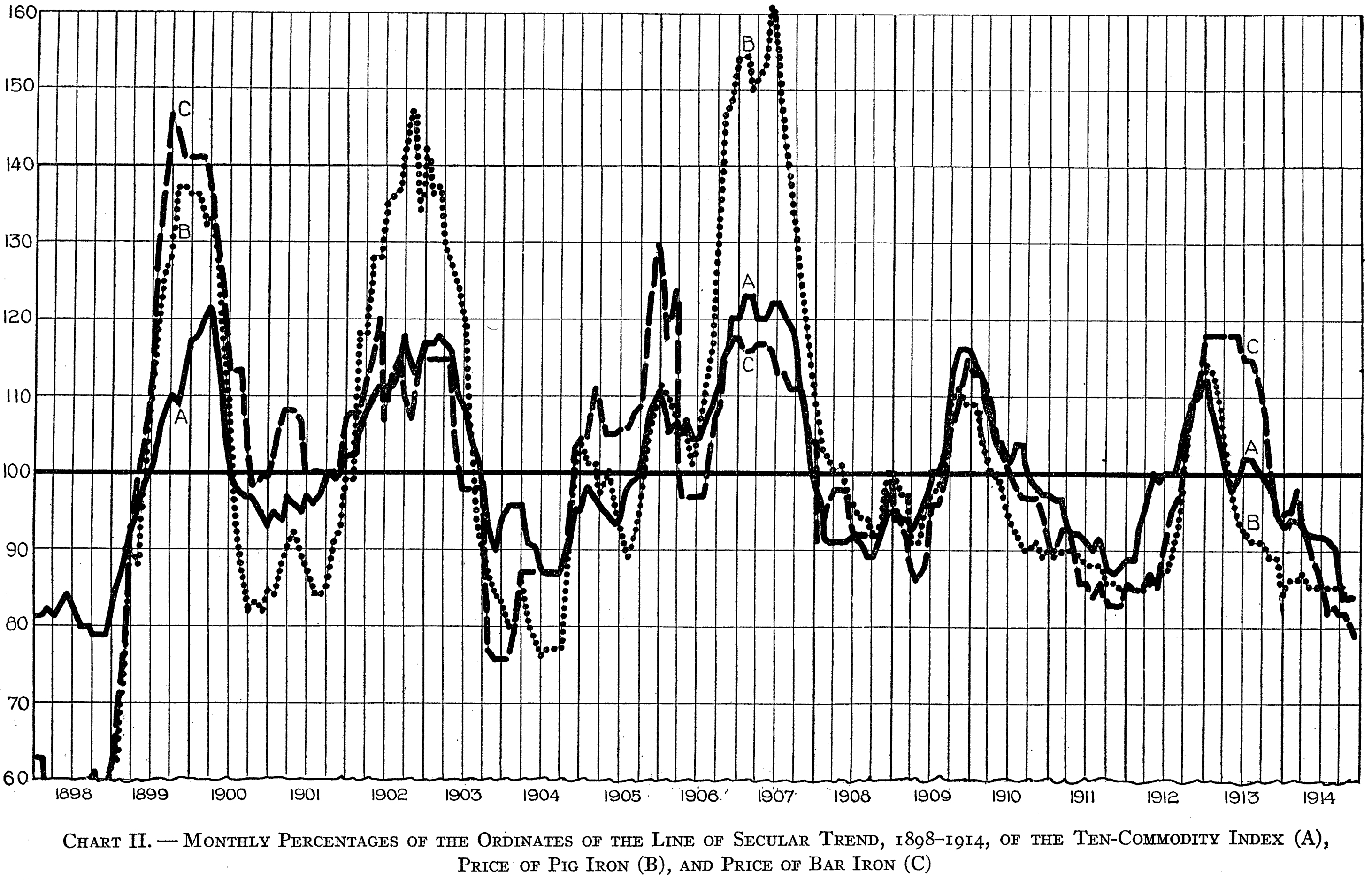

Chart II. — Monthly Percentages of the Ordinates of the Line of Secular Trend, 1898–1914, of the Ten-Commodity Index (A), Price of Pig Iron (B), and Price of Bar Iron (C)

Table I. — Relative Prices of Ten Commodities and Geometric Mean of Such Relative Prices, 1919–21

(*Arithmetic mean for 1919 = 100* *)

Date	Pig Iron			Bar Iron			Spelter			Hides			Coke			Pork		
	1919	1920	1921	1919	1920	1921	1919	1920	1921	1919	1920	1921	1919	1920	1921	1919	1920	1921
January 1	108.9	126.5	123.0	117.4	111.1	99.3	109.7	136.3	80.3	75.0	100.0	47.4	129.3	129.3	113.1	96.2	90.4	55.8
February 1	108.9	140.5	105.4	110.0	111.1	99.3	91.1	129.1	71.7	75.0	102.6	39.5	107.7	129.3	97.0	96.2	84.6	59.6
March 1	108.9	140.5	93.1	108.1	129.6	96.3	89.7	125.5	68.2	69.7	100.0	31.6	91.6	129.3	97.0	94.3	78.9	57.7
April 1	94.0	140.5	87.8	92.6	138.9	88.1	94.0	121.9	66.7	72.4	92.1	23.7	86.2	129.3	86.2	97.2	80.8	53.9
May 1	94.0	147.6	80.8	92.6	138.9	88.1	86.4	114.0	71.0	82.9	94.7	28.9	75.4	237.0	70.0	109.6	80.8	48.1
June 1	90.5	147.6	77.3	92.6	138.9	83.3	88.2	110.4	68.2	103.9	92.1	36.8	86.2	301.7	70.0	112.0	78.9	46.2
July 1	87.0	147.6	75.5	92.6	138.9	77.8	101.9	108.3	62.4	110.5	92.1	35.5	91.6	366.3	64.7	110.6	76.0	46.2
August 1	94.0	147.6	66.8	97.0	138.9	64.8	106.2	110.4	60.3	139.5	76.3	36.8	83.0	388.0	59.3	115.4	63.5	47.1
September 1	97.5	147.6	66.8	97.0	138.9	64.8	107.6	116.2	59.1	110.5	71.0	36.8	104.5	366.3	64.7	100.0	61.6	49.1
October 1	98.4	147.6	66.8	97.0	138.9	64.8	100.4	107.6	65.3	126.3	71.0	38.2	86.2	355.6	70.0	88.5	59.6	48.1
November 1	98.4	133.5	66.8	100.7	138.9	64.8	108.3	99.0	65.3	123.7	63.2	38.2	118.5	193.9	66.8	88.5	57.7	48.1
December 1	119.5	133.5	63.2	102.6	120.4	61.1	116.2	80.3	66.7	110.5	52.6	42.1	140.0	161.6	59.3	91.4	57.7	48.1
Average for year	100.0	141.7	81.2	100.0	131.9	79.3	100.0	113.3	67.2	100.0	83.9	36.3	100.0	240.7	76.5	100.0	72.5	50.6

* The actual average prices for 1919, used as the base in each case, are: pig iron, $28.46 per gross ton; bar iron, $.027 per lb.; spelter, $.0697 per lb.; hides, $.38 per lb.; coke, $4.64 per short ton; pork, $51.98 per bbl.; cottonseed oil, $.1908 per lb.; cotton sheetings, $.2038 per yd.; print cloths, $.106 per yd.; worsted yarns, $2.23 per lb.

with the comparison of the cyclical fluctuations. If the price trends of the various commodity price series which we are comparing had been approximately the same the elimination of the trends would not have been a necessary preliminary to a comparison of the cyclical fluctuations. But, in fact, the long-time trends for 1898–1914 of the ten commodities of our price index of business cycles differ greatly, as is shown by Chart III. In this chart are given the "lines of secular trend" of the ten commodities compared with the line of secular trend of the "all commodities" index of the United States Bureau of Labor Statistics.[1] In Chart II, as has been said, are given the percentages of "normal" (i. e. the lines of secular trend) of pig iron, bar iron, and the average percentages of "normal" of ten commodities. This chart was constructed in order to determine whether, previous to commercial crises, steady declines in the prices of iron and steel regularly precede or follow similar declines in other prices. We conclude that in 1899 and 1902 declines in the prices of pig iron and bar iron preceded by some months declines in other commodities, but in more recent years, 1907, 1909 and 1912, declines in prices of pig iron and bar iron show no tendency to forecast declines in other prices. In fact, on the whole, the tendency appears to be for recessions in iron and steel prices to come late rather than early in a period of liquidation and readjustment to lower levels.

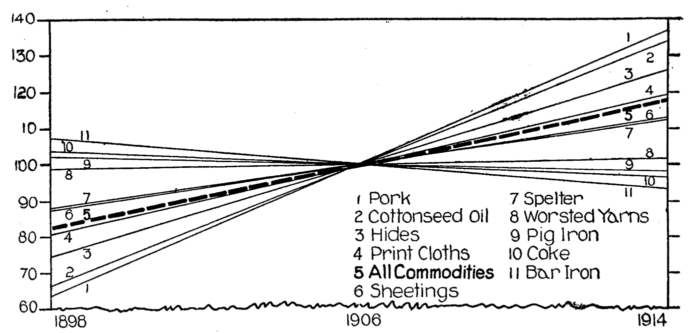

Chart III. — The Lines of Secular Trend of Ten Series of Commodity Prices and of the Index of the Bureau of Labor Statistics for All Commodities, 1898–1914

It will be noticed from Chart II that the prices of pig iron vary over a wider range than do the prices of bar iron. Since 1907, however, the range of fluctuation of the prices of pig iron, bar iron, and the average of ten commodities has been the same.

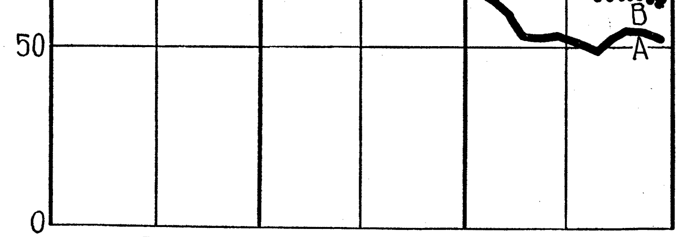

Chart IV. — The Ten-Commodity Index (A) and the Monthly Wholesale Prices of Bar Iron (B) and Pig Iron (C)

(*Monthly average for 1919 = 100*)

Chart IV compares the prices of pig iron, bar iron, and the average of ten commodities for the period 1919–21.[2] It is clear that in the crisis of 1920 the prices of

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[1] The average annual price increases of each of the ten commodities and of "all commodities" of the Bureau expressed as percentages of the average price of the respective series for 1898–1914 are: pork, 4.28; cottonseed oil, 3.94; hides, 3.06; print cloths, 2.26; all commodities, 2.06; sheetings, 1.50; spelter, 1.47; worsted yarns, .19; pig iron, –.24; coke, –.39; bar iron, –.84.

[2] Monthly wholesale prices of pig iron and common iron bars are reduced to percentages, of which the base is the 1919 monthly average. The ten-

TABLE I. — RELATIVE PRICES OF TEN COMMODITIES AND GEOMETRIC MEAN OF SUCH RELATIVE PRICES, 1919–21

(Arithmetic mean for 1919 = 100)*

Date	COTTONSEED OIL			COTTON SHEETINGS			PRINT CLOTHS			WORSTED YARNS			GEOMETRIC MEAN		
	1919	1920	1921	1919	1920	1921	1919	1920	1921	1919	1920	1921	1919	1920	1921
January 1	91.7	104.8	30.1	93.2	137.4	54.0	92.0	136.8	59.0	89.7	120.2	53.8	99.2	118.2	65.8
February 1	91.7	102.2	31.4	88.3	147.2	54.0	82.5	155.6	59.0	86.1	120.2	56.0	93.1	120.4	62.9
March 1	91.7	91.7	26.2	78.5	152.1	49.1	68.4	150.9	54.2	87.4	143.5	56.0	87.8	121.6	57.9
April 1	91.7	86.5	21.0	73.6	152.1	45.4	68.4	155.6	47.2	87.9	143.5	56.0	85.2	121.0	51.9
May 1	91.7	79.9	26.2	76.1	152.1	41.7	77.8	165.1	44.8	88.8	144.4	56.0	87.0	128.5	51.7
June 1	104.8	83.9	28.8	98.1	147.2	41.7	103.7	153.3	44.8	91.9	132.3	54.3	97.0	128.6	52.3
July 1	117.9	68.1	31.4	105.5	139.8	41.7	106.1	150.9	43.6	96.4	107.6	50.2	101.6	124.3	50.7
August 1	123.2	55.0	36.7	110.4	137.4	41.7	117.9	127.3	44.8	105.4	105.4	48.4	108.1	115.7	49.6
September 1	104.8	55.0	36.7	112.8	107.9	49.1	113.2	108.5	51.9	112.1	93.3	48.4	105.8	108.7	51.7
October 1	89.1	49.8	40.6	112.8	98.1	63.8	113.2	94.2	61.3	116.6	89.7	45.7	102.1	103.2	55.3
November 1	102.2	41.9	38.0	122.7	83.4	63.8	127.3	73.1	63.7	116.6	76.2	45.7	110.0	87.2	54.8
December 1	99.6	33.5	36.2	127.6	63.8	49.1	129.7	61.3	59.0	120.2	59.2	45.7	114.8	74.0	52.1
Average for year	100.0	71.0	32.0	100.0	126.5	49.5	100.0	127.7	52.8	100.0	111.2	51.6	100.0	114.8	55.2

* The actual average prices for 1919, used as the base in each case, are: pig iron, $28.46 per gross ton; bar iron, $.027 per lb.; spelter, $.0697 per lb.; hides, $.38 per lb.; coke, $4.64 per short ton; pork, $51.98 per bbl.; cottonseed oil, $.1908 per lb.; cotton sheetings, $.2038 per yd.; print cloths, $.106 per yd.; worsted yarns, $2.23 per lb.

iron and steel did not recede until late in the year, about six months after the price collapse of textiles, hides, and other commodities.

Production. Annual indices of (A) the physical volume of production for ten groups of manufactures [1] and (B) the consumption of pig iron are compared in Chart V. Both series have been adjusted for their long-time movement during the period 1899–1913 and therefore the comparison merely shows the correspondence of the year-to-year fluctuations. The range in the consumption of iron and steel is from 67 per cent of normal in 1908 to 118 per cent of normal in 1906 and 1916, while the range of production for all groups is from 88 per cent in 1908 to 111 per cent in 1906 and 1916. The minima and maxima for iron and steel and for all groups of manufactures occur in the same years. In other words, the comparison shows that the consumption of pig iron is a sensitive and exceedingly accurate index of the year-to-year fluctuations of the output of manufactures in general.

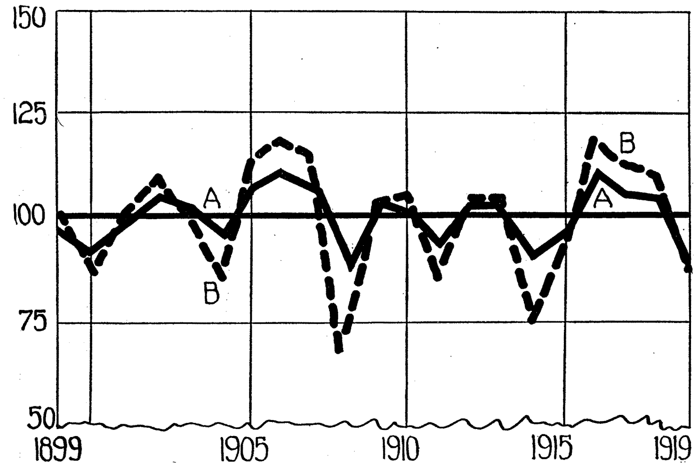

CHART V. — ADJUSTED ANNUAL INDICES OF PHYSICAL PRODUCTION FOR ALL MANUFACTURING GROUPS (A) AND FOR IRON AND STEEL (B), 1899–1919

(Ordinates of secular trend 1899–1913 = 100)

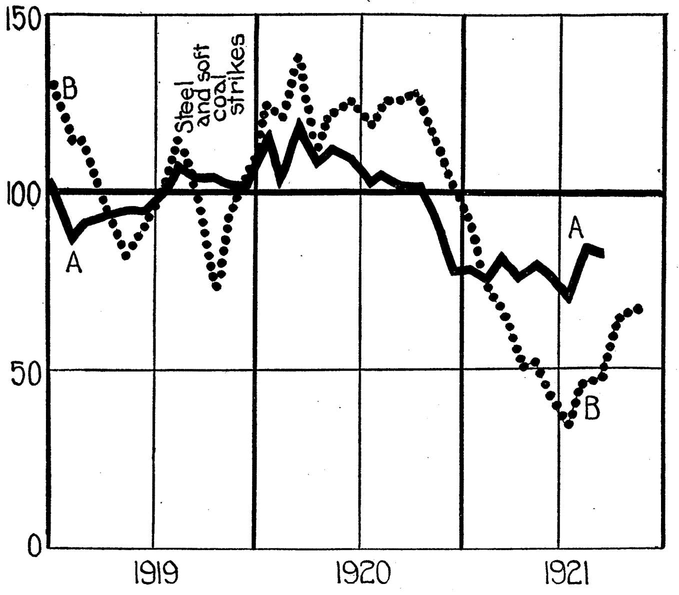

CHART VI. — UNADJUSTED INDICES OF THE VOLUME OF MANUFACTURE (A) AND THE PRODUCTION OF IRON AND STEEL (B), 1919–21

(Monthly average for 1919 = 100)

For the period 1919–21 monthly indices of the volume of manufacture for all groups and for the iron and steel industry are available.[2] A comparison of these indices, both expressed relative to the average for 1919 as 100, is given in Chart VI. The general movements of the two curves correspond in direction, but the range or amplitude of fluctuations is greater for iron and steel

commodity price index for 1919–21 was obtained as follows: First unweighted geometric means of the actual monthly prices of the ten commodities (pig iron, bar iron, spelter, coke, hides, cotton sheetings, print cloths, worsted yarns, salt mess pork, and cottonseed oil) were taken for January 1919 to date. The items of this series were then expressed as percentages of the geometric mean of the average annual prices of the ten commodities for 1919.

[1] An arithmetic mean based on 33 series. See the REVIEW, December, 1920, pp. 58–62, for data and details of the method employed.

[2] These indices and the data upon which they are based were published in the *Special Letter* for November 26, 1921 of the Harvard University Committee on Economic Research. Both indices are "unadjusted" for seasonal variation and secular trend.

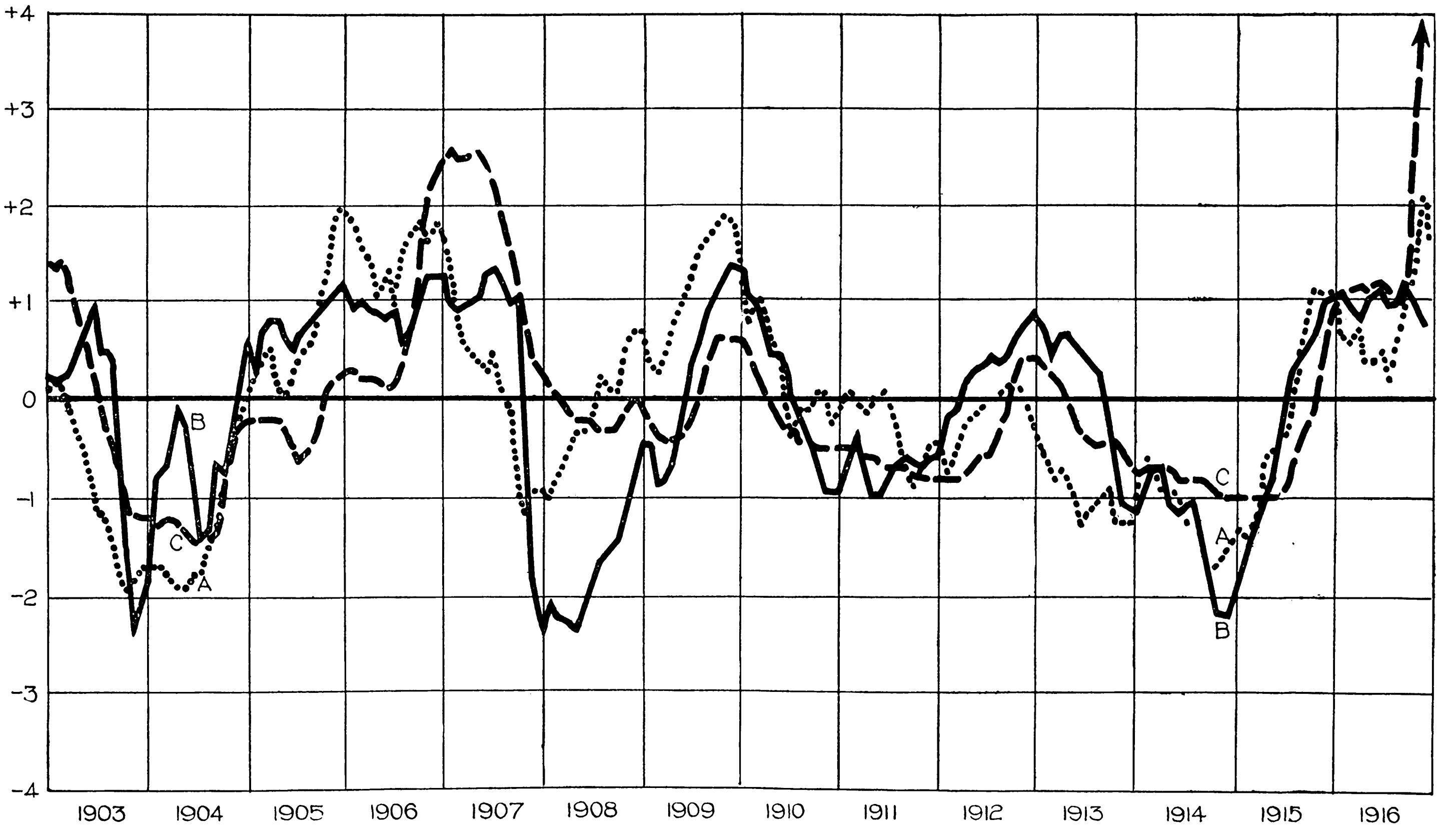

Chart VII. — Monthly Cycles, 1903–16, of Eight Iron and Steel Common Stock Index (A) of Pig Iron Production (B) and of the Average Price of Pig Iron (C). (*Ordinates of secular trend = 100*)

production. Iron and steel production was, of course, affected by the strikes in the autumn of 1919. It will be noticed that for production as for prices the decline in the iron and steel industry came late in 1920 and was forecast by general recessions in other industries. The decline in iron and steel production between October 1920 and July 1921 was more drastic than for any other crisis in our history.

In the following section the data concerning prices and production are brought together for comparison.

Prices and Production. Data are available for a comparison of the cycles of the average price of eight iron and steel common stocks,[1] the tonnage of pig iron produced in the United States, and the average price of four varieties of pig iron. Chart VII gives the curves for the three series just named for the period 1903–16, the figures being adjusted for the trend during the period covered and expressed in comparable units, the standard deviations. Chart VIII gives the curves for the average price of eight iron and steel common stocks, the adjusted index of the volume of manufacture of iron and steel and the price of one variety of pig iron.[2] The fluctuations relative to each other of the three curves on these two charts constitute the basis for the following conclusions:

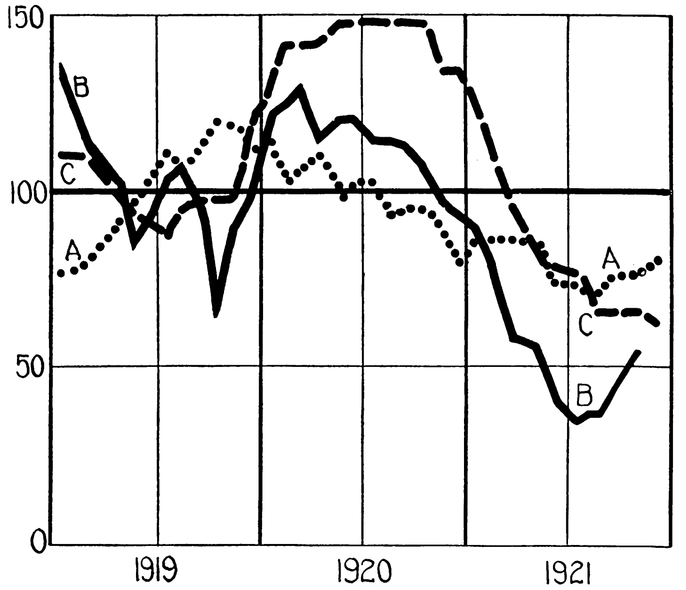

Chart VIII. — Monthly Price Index of Eight Iron and Steel Common Stocks (A), the Adjusted Index of the Volume of Production for Iron and Steel (B), and the Monthly Price of Pig Iron (C)

(*For (A) and (C) 1919 monthly average = 100; for (B) ordinates of secular trend = 100*)

First, previous to a crisis (or turning point downward of prices and production) the prices of iron and steel stocks culminate and begin a rapid decline in advance of declines in the production and price of pig iron. This relationship held in 1907, 1909–10, 1912–13, and 1919–20.

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[1] The stocks included are: American Car and Foundry Company, American Locomotive Company, Pressed Steel Car Company, Railway Steel Spring Company, Republic Iron and Steel Company, Sloss-Sheffield Steel and Iron Company, United States Cast Iron Pipe and Foundry Company, United States Steel Corporation. An unweighted geometric mean of the corresponding monthly averages of the high and low stock quotations was taken. The line of secular trend was then fitted and the standard deviation computed for the period 1903–13. (See pages 264–277 of the Review for August, 1921.) The monthly production of pig iron was taken from the *Iron Age*. The line of secular trend and the indices of seasonal variation were computed for the period 1903–16 (see pages 66, 67 of the Review for January, 1919). The average price of pig iron is Bessemer at Pittsburgh, Southern No. 2 foundry at Cincinnati, Local No. 2 foundry at Chicago, and Standard brands Eastern Pennsylvania No. 2 foundry at Philadelphia (quotations from the *Iron Age*).

[2] The iron and steel common stock series is an unweighted geometric mean of the corresponding monthly averages of high and low quotations of the stocks reduced to a series relative to the 1919 monthly average. The adjusted index of the volume of manufacture of iron and steel is based on pig iron produced. See *Special Letter* for November 26, 1921. The prices of pig iron at No. 2 foundry, southern Birmingham are here reduced to a series of which the base is the 1919 monthly average.

Second, after a period of violent declines the volume of production was as prompt or almost as prompt to revive as the prices of iron and steel stocks. Thus, note the relationship in 1904, 1911–12, 1914–15, and 1921. In 1908, however, the prices of stocks began a persistent up-swing three months before production recovered from the depression.

Third, during the years of revival in the period 1903–16 an increase in the volume of production of pig iron antedated an increase in prices of that commodity. Thus, note the relationship in 1904, 1908–09, 1911–12, and 1914–15. During years of crisis and decline, however, recessions in production and prices of pig iron occurred almost simultaneously, as in 1907, 1909–10, and 1912–13.

Fourth, in 1920 the unusual relationship occurred of a decline in production beginning some six or eight months before a decline in prices.

Table II. — Percentage of the Price of Pig Iron to Corresponding Ordinate of Secular Trend, 1898–1914

Date	1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914
January 1	60	61	136	85	99	142	83	104	111	154	109	100	109	90	85	114	84
February 1	59	63	136	84	99	136	80	101	110	154	103	97	109	89	85	113	86
March 1	59	77	132	88	118	137	80	101	108	150	102	97	104	90	85	110	86
April 1	59	90	133	90	118	130	85	97	105	151	100	91	102	90	86	105	87
May 1	59	88	127	92	128	127	80	100	106	153	101	91	100	90	86	98	85
June 1	59	99	117	89	128	124	78	96	101	161	96	94	98	89	87	94	85
July 1	59	109	109	87	135	119	76	93	104	156	96	97	94	88	87	92	85
August 1	59	117	93	84	136	105	77	89	110	144	94	98	92	88	89	91	85
September 1	60	126	87	84	137	94	77	92	116	138	94	101	90	88	93	91	85
October 1	59	128	82	85	142	90	77	96	129	129	92	109	90	86	102	91	85
November 1	59	137	83	91	147	87	89	104	146	122	93	111	91	86	109	89	84
December 1	60	137	82	93	134	84	101	109	149	116	100	109	89	85	110	89	84

Table III. — Percentage of the Price of Bar Iron to Corresponding Ordinate of Secular Trend, 1898–1914

Date	1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914
January 1	63	62	141	99	107	115	76	105	126	118	104	94	113	90	86	118	95
February 1	63	68	141	103	108	115	76	105	117	116	91	94	113	90	85	118	95
March 1	58	77	141	108	108	115	80	111	124	116	97	92	112	93	85	118	98
April 1	58	92	138	108	112	115	87	107	104	117	98	88	110	93	85	118	93
May 1	58	98	131	108	115	115	87	105	97	117	98	86	105	90	87	118	92
June 1	58	105	124	106	120	102	87	105	97	116	98	88	103	86	85	118	88
July 1	58	112	113	100	107	98	87	106	97	113	92	96	100	86	91	115	86
August 1	58	127	113	100	112	98	87	106	97	113	92	96	99	84	95	115	82
September 1	60	140	113	100	115	98	87	108	107	111	92	100	97	86	97	113	83
October 1	61	146	102	100	110	98	87	109	108	111	92	106	97	83	102	110	82
November 1	58	144	98	100	107	77	89	120	115	111	92	108	97	83	107	100	82
December 1	56	141	99	100	115	76	103	130	118	104	99	115	94	83	114	94	79

Table IV. — Adjusted Price Index of Business Cycles, 1898–1914

(*Average of percentages to ordinates of secular trend for ten commodities*)

Date	1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914
January 1	81	82	117	93	103	117	94	95	110	120	98	95	115	97	89	112	93
February 1	81	85	118	95	102	117	96	98	105	123	92	94	113	96	89	108	94
March 1	82	90	120	94	106	118	96	97	106	123	91	94	112	96	92	105	94
April 1	81	95	121	97	108	117	96	95	105	120	91	93	108	93	95	102	94
May 1	82	96	116	96	110	116	91	94	107	120	91	95	104	92	100	98	92
June 1	84	99	109	95	111	111	90	93	104	122	91	97	104	92	99	99	92
July 1	82	100	101	97	111	109	88	94	104	122	92	100	102	91	100	102	92
August 1	80	104	98	96	111	103	87	98	107	120	91	100	104	90	100	102	91
September 1	80	107	97	97	114	102	86	99	108	119	89	105	104	91	101	101	90
October 1	79	110	97	100	118	99	87	102	111	117	89	113	100	88	105	99	84
November 1	79	109	96	99	113	92	90	107	116	110	91	116	98	87	109	97	84
December 1	79	114	94	100	115	90	95	109	120	100	95	116	97	88	111	94	84